International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Water Quality Analysis of Kaliyar-Muvattupuzha River

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Abstract – River is considered as a main source to meet the increasing demands of electricity, irrigation, domestic and industrial water supply etc. One of the main problems faced by other rivers likeGanga, Yamuna etc. is large scale pollution. The water bodies are so polluted that. in addition to affecting thequality of water required for various uses, the fish and other aquatic life are also greatly affected in such waterbodies. The studies thereby conducted clearly reveal the intensity of pollution and other issues in Kaliyar – Muvattupuzha River.

1.INTRODUCTION

Kerala is blessed with 44 Rivers of which 41 are west flowing and 3 east flowing. Considerable part of this limited quality of water is polluted by sewage, industrial waste and a wide range of synthetic chemicals due to increasing industrialization on one hand and exploding population on the other. The dumping of materials, encroachments, deforestation, conversion of wet lands etc. has caused dwindling offlow through the rivers also. The study conducting for clearly reveals the intensity of pollution and other issues in Muvattupuzha-Kaliyar River.

2. STUDY OF SITE

Kaliyar River is a major tributary which along with two other tributaries, Thodupuzha River and Kothamangalam River, forms Muvattupuzha River which is one of the major perennial Rivers in Kerala. Muvattupuzha River which flows in South-West direction after the confluence, traversesa total length of 121 km. The total drainage area of Muvattupuzha River basin is 1554 km^2, which is formed of four sub basins (Muvattupuzha, Kothamangalam, Kaliyar and Thodupuzha). Kaliyar basin covers a drainage area of 405 km^2 and has a total length of 21 km. It is the largestof the three tributaries of Muvattupuzha River. Kaliyar originates from Taragamkanam at an elevation of 1094m. Kaliyar basin area falls under mainly high land (> 75 AMSL) and mid land (75 - 8 AMSL). The river meets Kothamangalam River near Kakkadassery and flows downto meet Thodupuzha River near Muvattupuzha town and forms Muvattupuzha River. The drainage basin of Muvattupuzha River spreads over Idukki, Kottayam, Alappuzha and Ernakulam districts. Kaliyar basin spreads over Idukki and Ernakulam districts only. The riverbasin lies between N latitude 9^{0}45’ & 10^{o}05’ and E longitude 76^{o}22’ – 76^{o}50’.

Table -1: Details of sampling stations

POINTS	LOCATION	LATIITUDE	LONGITUDE
KALYR01	Near Muhiyidheen Juma Masjid, Thommankuthu	9.95953	76.82151
KALYR02	Near St. Kuriakose minor seminary	9.94871	76.82125
KALYR03	Near St. Mary’s chapel	9.94842	76.81364
KALYR04	Near Thommankuthu Bridge	9.95137	76.81757
KALYR05	Near Shanthikatu Devi Temple	9.95423	76.81863
KALYR06	Pachila	9.96762	76.7932
KALYR07	Kaliyar Bridge (Top)	9.97407	76.78276
KALYR08	Kaliyar Bridge (Bottom)	9.97418	76.78068
KALYR09	Thennathoor Bridge (Top)	9.98852	76.74869
KALYR10	Thennathoor Bridge (Bottom)	9.98707	76.75638

3.EXPERIMENTS

3.1Water Sampling Procedure and Analysis

Ten locations were fixed for collection of samples from Thommankuthu to Thennathoor.

Plastic bottles of 2-liter capacity with stopper were used for collecting samples. Each bottle was washed with hot water and then rinsed three times with distilled water. The bottles were then preserved in a clean place.

Water sample was collected from the center of the river at a reasonable depth.

3.2Testing Of Water Samples

The water samples were analyzed for various parameters in the laboratory of Environmental Engineering, Mar Baselios Institute of Science and Technology. Various physical and chemical parameters like Colour, Taste, Odour, pH, Turbidity, Acidity, Alkalinity, Sulphate, Chloride, Iron, Hardness, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and MPN have been monitored for the river and well water of different locations.

3.2.1Water Quality Parameter

pH-pH is an indicator of acidity or alkalinity. pH is a logarithmic scale and an increase or decrease of one pH unit is a 10-fold change. Neutral water has a pH of 7, acidic solutions have values between 0- 6 and alkaline solutions have values between 8 and 14.

Turbidity-It is a measure of the cloudiness or haziness in water caused by suspended solids (e.g.: sediment, algae). Turbidity is expressed in Nephelometric Turbidity Units (NTU) and is measured using a relationship of light reflected from a given sample.

Total Hardness-Hardness is predominantly caused by divalent cations such as calcium, magnesium, alkaline earth metal such as iron, manganese, strontium, etc. The total hardness is defined as the sum of calcium and magnesium concentrations, both expressed as CaCO3 in mg/L.

Sulphate-Sulphate in drinking water currently has a secondary maximum contaminant level of 250mg/L based on aesthetic effects. This regulation is not a federally enforceable standard, but is provided as a guideline for states and public water systems.

Iron-Iron can be present in water in two forms; the soluble ferrous iron or insoluble ferric iron. Water counting ferrous iron is clear and colourless. Healthy level of iron in water is less than 0.3 mg/L

Dissolved Oxygen (DO)-Dissolved oxygen is oxygen gas molecules (O2) present in the water. Consistently high levels of dissolved oxygen are best for a healthy ecosystem. Levels of dissolved oxygen vary depending on factors including water temperature, time of day, season, depth, altitude, and rate of flow.

Chlorides-The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl-).

Biological Oxygen Demand (BOD)-Biological Oxygen Demand (BOD) is the amount of oxygen required by microorganisms for stabilizing biologically decomposable organic matter (carbonaceous) in water under aerobic conditions. The test is used to determine the pollution load of wastewater, the degree of pollution and the efficiency of wastewater treatment methods. 5-Day BOD test being a bioassay procedure (involving measurement of oxygen consumed by bacteria for degrading the organic matter under aerobic conditions) requires the addition of nutrients and maintaining the standard conditions of pH and temperature and absence of microbial growth inhibiting substance.

Chemical Oxygen Demand (COD)-Chemical oxygen demand (COD) is the measure of oxygen equivalent to the organic content of the sample that is susceptible to oxidation by a strong chemical oxidant. The intrinsic limitation of the test lies in its ability to differentiate between the biologically oxidizable and inert material. It is measured by the open reflux method.

Most Probable Number (MPN)-MPN is a statistical method based on the random dispersion of microorganisms per volume in a given sample. In this method, measured volume of water is added to a serious of tubes containing liquid indicator growth medium

Table-2: Surface Drinking Water Standards IS: 2296:1992

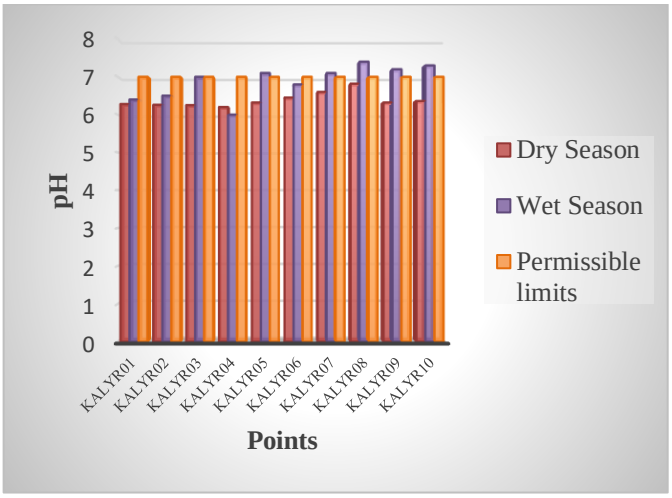
SI.NO	Parameter and Unit	Limit of class A
1	Taste	None
2	Odour	Unobj.
3	Colour (True) (Hazen unit)	10
4	PH (max)(min:6.5)	8.5
5	DO (mg/L) (minimum)	6
6	BOD(3d,27OC) (mg/L)	2
7	Total Coliforms (MPN/100mL)	50
8	Total Hardness (mg/L as CaCO3)	300
9	Chlorides (mg/L as Cl)	250
10	Sulphates (mg/L as SO4)	400
11	Iron(mg/L)	0.3
12	COD (mg/L)	0
13	TDS (mg/L)	500
14	Turbidity (NTU)	<5

3.2.2Comparison Of River Water Characteristics During Wet and Dry Season

3.2.2.1 pH Value

A pH range of 6.5 – 8.5 isnormally acceptable as per guidelines suggested by IS. In the present study, the fluctuation of pH in dry season is from 6.2-6.82 and in wet season pH value various from 6 to 7.4

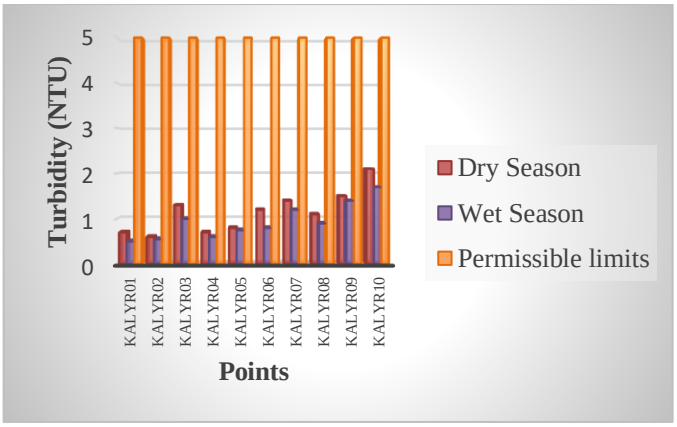
Chart 1: pH



3.2.2.2Turbidity

It ranged from 0.6-1.5 NTU in dry season and vary from 0.5-1.2 in wet season. However, the prescribed limit of Turbidity for drinking water is 5 NTU (IS: 10500).

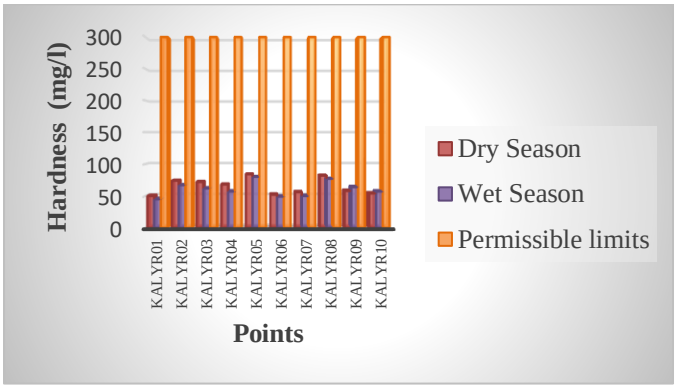
Chart 2: Turbidity



3.2.2.3 Total Hardness

The permissible limit of Hardness for drinking water is 300 mg/l (IS 10500). In the present study, the fluctuation of hardness in dry season is from 50-84 and in wet season chloride value various from 50-80. Hardness was found within the permissible limit in all the water sample.

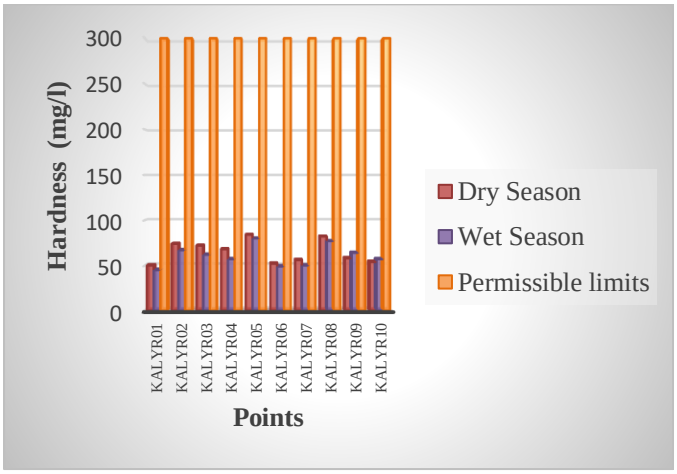
Chart 3: Total Hardness



3.2.2.4Sulphate

The permissible limit of sulphate for drinking purpose is 400mg/L. In the present study, the fluctuation of sulphate in dry season is from 5.6 to 9 and in wet season sulphate value various from 5.4-8.9.

Chart 4: Sulphate



3.2.2.5 Chloride

In the study area there is no significant change in chloride concentration. Chloride which has been associated with pollution as an index are found below the permissible value set at 250 mg/l in the study area. The fluctuation of chloride in dry season is from 0 to 4.96 and in wet season chloride value various from 0.9-3.87.

Chart 5: Chloride

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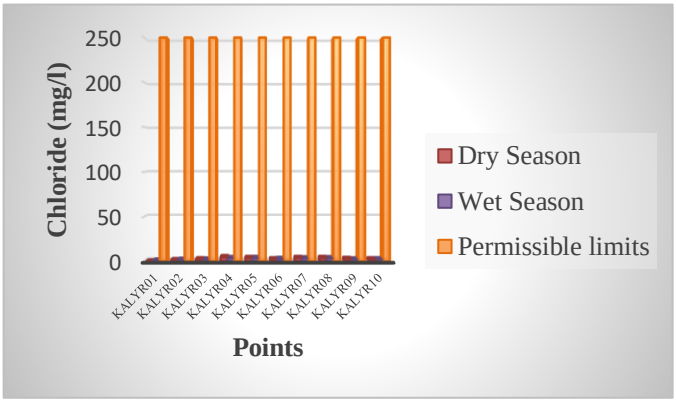
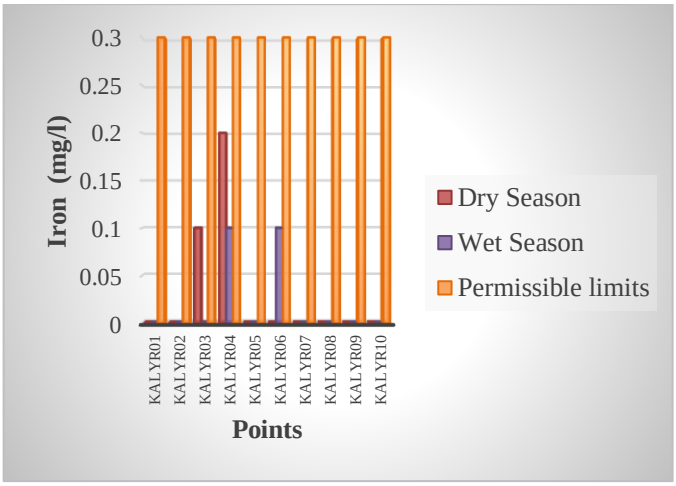


3.2.2.6 Iron

In the study area there is no significant change in iron concentration. The permissible value of iron is 0.3 mg/L. In the present study, the fluctuation of iron in dry season is from 0 to 0.2 and in wet season iron value various from 0 to 0.1. iron was found with in the permissible limit in all the water sample.

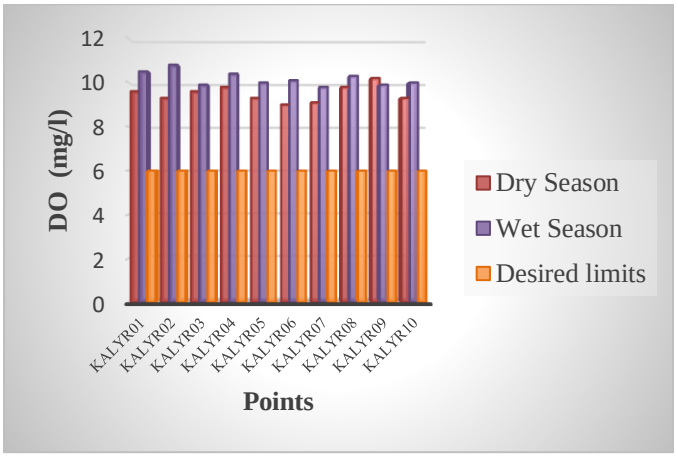
Chart 6: Iron



3.2.2.7 Biochemical Oxygen Demand

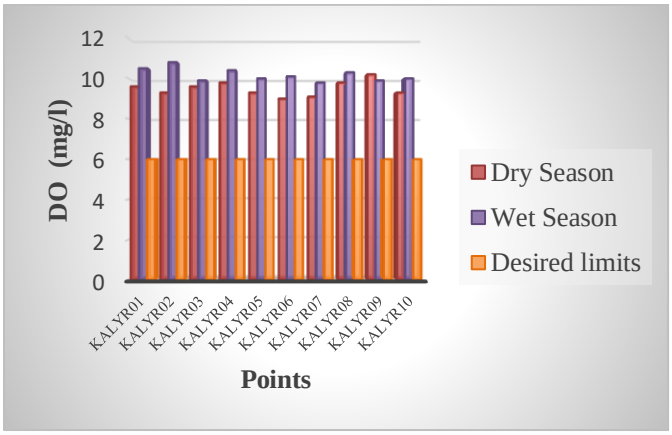
The fluctuation of BOD in dry season is from 0.3-0.9 and in wet season BOD value various from 02-0.6. It is found that all the water sample within the permissible limit. The low BOD value in all samples showed good sanitary condition of the water.

Chart 7: BOD



3.2.2.8 Dissolved Oxygen

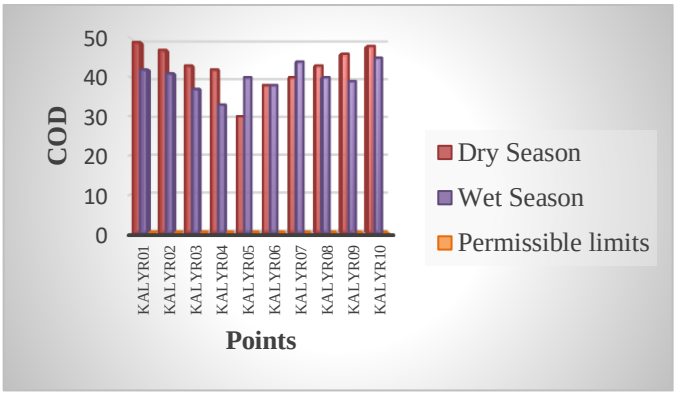
Low oxygen content in water is usually associated with organic pollution. The prescribed limit for DO is 5.0 mg/l. In the present study, the fluctuation of DO in dry season is from 9 to 10.20 and in wet season DO value various from 9.8-10.8 Chart 8: DO



3.2.2.9 Chemical Oxygen Demand

The drinking water should not contain COD. But all the sample contains a small number of COD. In the present study, the fluctuation of COD in dry season is from 30-49 and in wet season COD value various from 33-44.

Chart 9: COD



3.2.2.10 Most Probably Number

The presumptive test with A1 broth as nutrient medium, indicating the presence of bacteria was done with all the collected samples.
As a result, all the samples were tested positive for Bacteria.

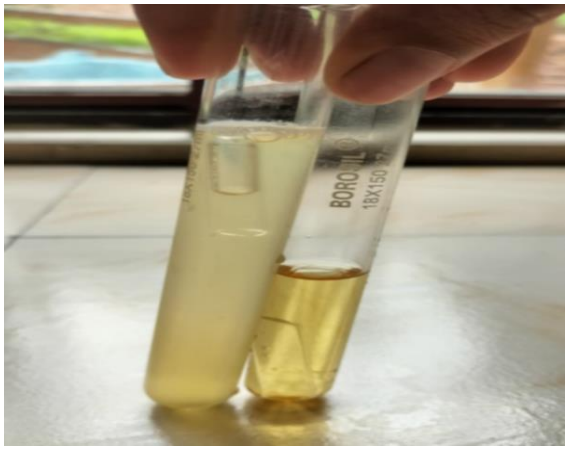


Fig -1: Difference between Sample+Broth and Broth

Fig-2: Samples+Broth after incubation

4 WATER QUALITY INDICES

Water Quality Index (WQI) provides a single number that expresses the overall water quality, at a certain location and time, based on several water quality parameters. The various parameters considered for the calculation of WQI are – pH, DO, BOD, Hardness, Chloride, Sulphate, Iron, COD and Turbidity.

4.1 Calculation of Water Quality Indices

The Water Quality Index (WQI) was calculated using the Weighted Arithmetic Index method.

Unit weight W_n factors for each parameter by using the formulae

$W_n = K/S_n$

Where,

$K=1/ (1/S_1+1/S_2+1/S_3+\ldots\ldots\ldots+1/S_n)$

S_n=standard desirable value of the n^{th} parameters

Calculation of sub index value (Q_n)

$Q_n = (V_n/S_n)$ x100

Where,

Vn=mean concentration of n^{th} parameters

S_n= standard desirable value of the n^{th} parameters

4.2 Water Quality Status

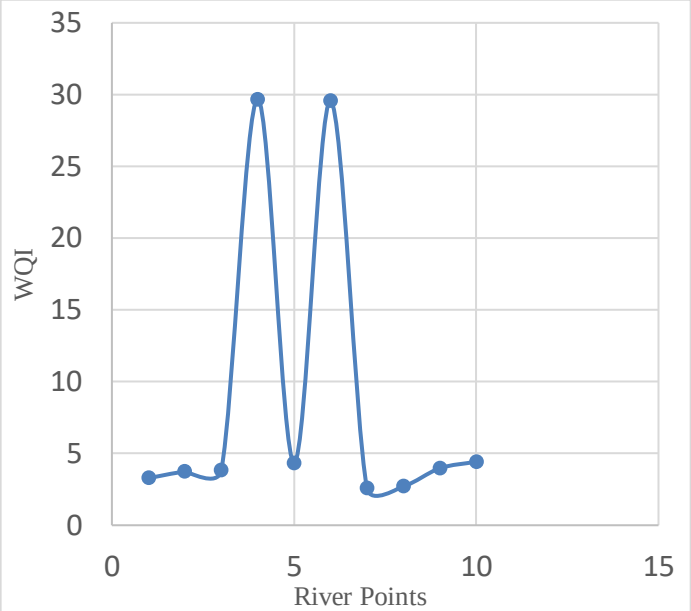
Table 3: Water Quality Status

Water quality index level (WQI)	Water quality status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
>100	Unsuitable for drinking

4.3 Variation of WQI during Dry Season

Station points	WQI	Water quality status
KALYR01	4.260	Excellent
KALYR02	4.209	Excellent
KALYR03	33.302	Good
KALYR04	77.451	Very poor
KALYR05	5.432	Excellent
KALYR06	4.396	Excellent
KALYR07	3.752	Excellent
KALYR08	3.663	Excellent
KALYR09	6.078	Excellent
KALYR10	6.556	Excellent

Chart 10: WQI during Dry Season

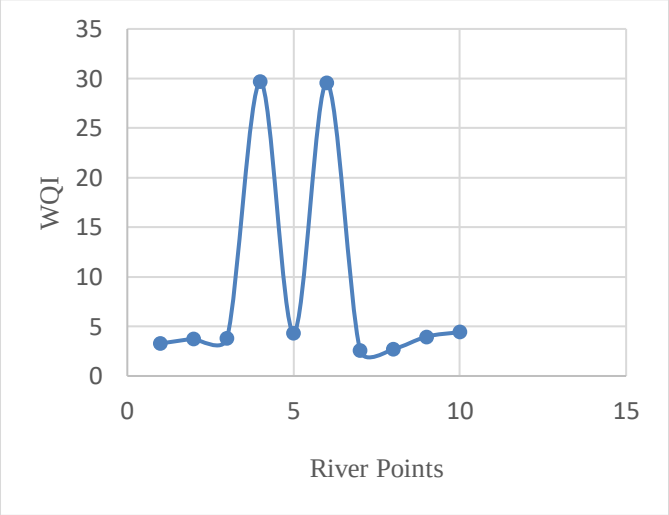


4.4 Variation of WQI during Wet Season

Station points	WQI	Water quality status
KALYR01	3.283	Excellent
KALYR02	3.733	Excellent
KALYR03	3.816	Excellent
KALYR04	29.681	Good
KALYR05	4.347	Excellent

KALYR06	29.563	Good
KALYR07	2.578	Excellent
KALYR08	2.724	Excellent
KALYR09	3.975	Excellent
KALYR10	4.425	Excellent

Chart 11: WQI during Wet Season



3. CONCLUSIONS

From the study we concluded that quality of water is excellent for most of the points except for some points. The Water Quality Indices were found to be 4.260,4.209,33.302, 77.451, 5.432, 4.396, 3.752, 3.662, 6.708, 6.558 during the dry season and 3.283, 3.733, 3.816, 29.681, 4.347, 29.563, 2.578, 2.724, 3.975, 4.425 during the wet season for points KALYR01, KALYR02, KALYR03, KALYR04, KALYR05, KALYR06, KALYR07, KALYR08, KALYR09, KALYR10 respectively. Also, tests for MPN turned positive for all points. Hence, Proper disinfection should be provided before any further consumption of the water and consumers must be aware of the mentioned situation.

ACKNOWLEDGEMENT

This work was done as our final year project in collaboration with the Water Resources Department, Government of Kerala in connection with the "PREPARATION OF DPR FOR ABATEMENT OF POLLUTION AND REJUVENATION OF 21 RIVERS"

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BIOGRAPHIES

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